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Indian Standard

METHODS OF MEASUREMENT FOR VIDEO TAPE RECORDING AND REPRODUCING EQUIPMENT

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Indian Standard

METHODS OF MEASUREMENT FOR VIDEO TAPE RECORDING AND REPRODUCING EQUIPMENT

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(*Continued on page* 2)

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*Shri A. K. Sen was Chairman for the meeting in which this standard was finalized.

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Indian Standard

METHODS OF MEASUREMENT FOR VIDEO TAPE RECORDING AND REPRODUCING EQUIPMENT

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 18 September 1984, after the draft finalized by the Recording Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 This standard covers the methods of measurement of characteristics of video tape recording and reproducing equipment.

0.2.1 This standard applies to complete apparatus only and not to any component parts thereof.

0.3 While preparing this standard, assistance has been derived from IEC Publication 698 'Measuring methods for television tape machines', issued by the International Electrotechnical Commission.

0.4 In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard specifies the conditions and procedures for measurement of mechanical and electrical performance characteristics of video tape recording and reproducing equipment.

2. TERMINOLOGY

2.1 For the purpose of this standard, the terms and definitions specified in IS : 1885 (Part 48)-1978† shall apply.

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*Rules for rounding off numerical values (*revised*).

†Electrotechnical vocabulary: Part 48 Recording.

3. GENERAL CONDITIONS FOR MEASUREMENT

3.0 Unless otherwise specified, measurements shall be made under normal measuring conditions as specified below.

3.1 Normal Supply Voltage — The rated supply voltage shall be applied to the equipment.

3.1.1 The voltage applied to the equipment shall be held constant within 1·0 percent of the rated value during the measurement of the characteristic.

3.1.2 In case of ac mains operations, the voltage shall be applied at the rated frequency. The harmonic content of ac mains supply voltage shall not exceed 5·0 percent.

3.1.3 In case of battery operation, primary batteries of the type and rated voltage as specified by the manufacturers shall be used.

3.2 Atmospheric Conditions for Test

3.2.1 Unless otherwise specified all measurements shall be carried out under the following atmospheric conditions:

Temperature	15 to 35°C
Relative humidity	45 to 75 percent
Pressure	86 to 106 kPa (1 kPa = 10 m bar)

3.2.2 The equipment shall be protected from draught and direct radiation.

3.3 Accuracy of Test Set-Up — The test set-up employed to carry out measurements in accordance with this standard shall have an accuracy of at least one order better than that specified for the quantity under measurement.

3.4 Stereophonic Recording and Reproducing Equipment — Unless otherwise specified, measurements shall be carried out on each channel for stereophonic equipment.

3.5 Reporting — The test report shall clearly indicate the following:

a) Rated supply voltage type (ac or dc) and frequency in the case of ac,

b) Atmospheric conditions under which tests are carried out,

c) Any change of necessary adjustment to the equipment done before measurement, and

d) Results of tests.

4. OPERATING CONDITIONS

4.1 Before any measurements are made, the unit shall operate at least for the stabilization period specified by the manufacturer or 10 minutes whichever is greater.

4.2 Before any measurements are made all measuring equipment shall have reached temperature stability.

4.3 Apart from the specified load, the measuring equipment shall not introduce additional load which would significantly affect the parameters measured.

4.4 Before measurements are made, it should be ensured that parts of the equipment near or in contact with the tape are maintained clean and demagentized.

4.5 Unless permanently connected, all noise reductions and/or automatic gain control circuit shall be rendered inoperative.

4.6 If video and power ground points are provided separately, the equipment under test should be grounded at both these points separately.

5. TESTS

5.1 Diameter of the Headwheel (or Drum) — The drum diameter is measured by means of a precision micrometer. Measurements shall be made at several points on the drum, and these points shall be specified by the manufacturer.

5.2 Projection of Video Head Pole Tips — Measurements are also made by means of a dial indicator. Usually either the upper or lower drum serves as reference, depending on the specifications of the manufacturer. The measuring device is specified and often supplied by the manufacturer.

5.3 Radius of Curvature of the Vacuum Guide

5.3.1 *Reference Used for Measurements* — The basic reference used in the measurement of the radius of the vacuum guide is a master template. Such a template is made by fabricating a ring to a very precise inner diameter tolerance, and measuring the ring on a roundness metering apparatus to a specified accuracy of ±0·13 μm. The calibrated ring is then split across a diameter and two reference masters thus obtained. These reference masters are inspected to ascertain that no distoriton has occurred during the splitting process.

5.3.2 *Vacuum Guide Measuring Fixture* — The fixture consists of a solid-steel base with a precision spindle holding a dial indicator calibrated in divisions of 0·5 μm. A radius reference master is permanently affixed.

Two micrometer adjustment mechanisms are used to position the guides to be measured to be concentric with the radius of the reference master and a set of gauge blocks is used to adjust the vertical position of the spindle to measure the two 'lands' of the vacuum guide. The inherent accuracy of the spindle has been measured to be within the range of 0·5 μm total error.

5.3.3 *Method of Measurement* (*see Fig. 1*)

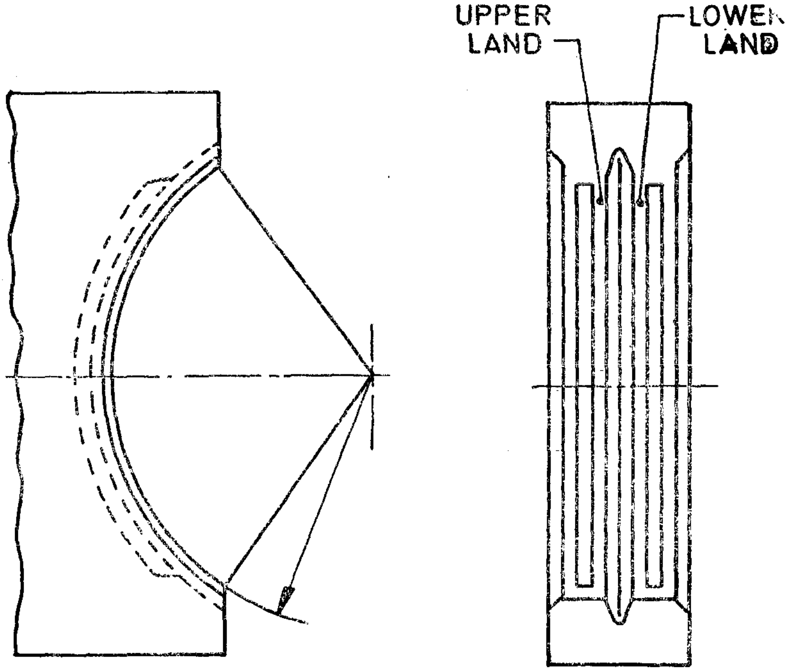

FIG. 1 MEASUREMENT OF RADIUS OF CURVATURE OF THE VACUUM GUIDE.

5.3.3.1 The dial indicator is zeroed against the radius of the reference master.

5.3.3.2 A master guide is placed into the fixture and its radius measured to verify the measurement system. This may be done daily or at other time intervals as is required.

5.3.3.3 The vacuum guide to be measured is placed into position on the fixture and centered with the micrometer mechanisms until it is concentric to the reference master. By observation of the difference in dial indicator reading between the guide radius and the reference radius an absolute radius dimensions is obtained. This is repeated for both 'lands'.

5.3.3.4 The perpendicularity of the cylindrical surface to the guide reference mounting surface is also checked by sliding the spindle vertically and observing the difference in readings between the 'lands'.

5.3.4 *Accuracy* — Evaluation of the results of this procedure, performed by a number of operators, has verified the accuracy obtained, including fixture repeatability, as being within a total range of 1·5 μm.

5.4 Longitudinal Pitch of the Video Tracks — The measurement shall be made between control track signals over a length of tape of one meter or a length appropriate to a travelling microscope. The number of control track signals for a given length of tape shall be counted.

5.5 Coplanarity Error of Video Heads — Two methods of measurement exist. The first is simple and suitable for field use, and the second more accurate and suitable for laboratory use.

5.5.1 *Method A* — Having made the tracks visible by magnetic development of the tape, this pattern is lifted from the tape by means of transparent adhesive tape. This latter tape is applied to a suitable piece of glass and the combination projected optically onto a large screen where coplanarity errors are observed and measured with reasonable accuracy.

5.5.2 *Method B* — Coplanarity errors may be measured directly on the headwheel by means of a precision microscope. It is not advisable to make the measurement on magnetically developed tape.

5.6 Video Track Curvature — Assuming that all tracks recorded by one head show the same curvature error, the following method can be applied:

Using a piece of magnetically developed tape the distance of each track from the reference edge of the tape ($A_K, K = 1 \ldots\ldots\ldots n$, *see* Fig. 2) is measured on a straight line perpendicular to the direction of tape motion and over the whole width of the tape area occupied by the video tracks. The difference $\triangle A$ between the average distance, given by the recording standard, and the actual distance is calculated as:

$$\triangle A = A_K - A_o - K_n (A_n - A_o)$$

and is suitably plotted on a graph.

5.7 Location of Control Track Record Along the Tape — Under consideration.

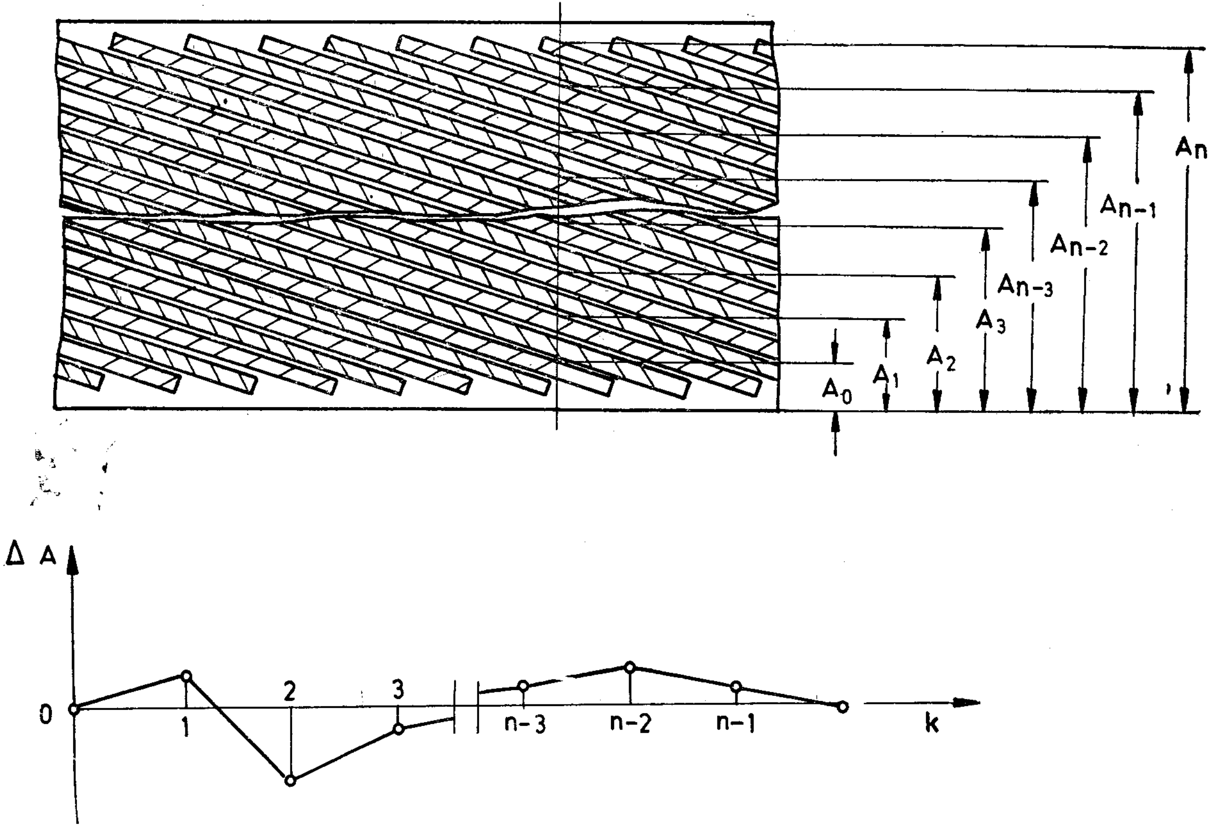

Fig. 2 Measurement of Video Track Curvature.

5.8 Jitter of Reproduced Picture

5.8.1 Several methods exist for measuring the time-base disturbances in the reproduced signals. Which one is used depends upon the accuracy required of the measurements balanced against the complexity of the measurements.

5.8.2 The methods given below apply to broadcast video-tape recorders. Methods applicable to non-broadcast recorders are under consideration.

5.8.3 A simple, quick technique is to view the reproduced picture on a receiver or monitor having either horizontal sweep circuitry controlled by AFC circuitry having a response time (RC time constant) of at least one second, or driven externally from a sync generator to which the tape machine is locked while reproducing the recording under measurement.

5.8.4 Viewing the horizontal jitter and geometric distortions in the reproduced picture gives a rough idea of the frequency of the disturbances and a very good idea of their amplitude when the picture width is related to the active line period of approximately 52 μs. If more accurate measurements are needed, the following methods may be employed.

5.8.5 If the reference source to which the machine is locked is not stable, the off tape H rate synchronizing pulses shall be compared in phase with an oscillator locked to the same pulses with a time constant of at least one second.

5.8.6 If the reference source to which the machine is locked is a stable source such as a television sync generator, the off tape H rate synchronizing pulses shall be compared in phase with the H rate sync pulses from the reference sources.

5.8.7 In both cases the resultant error voltage may be dealt with in two ways; it may be analysed by means of frequency selective voltmeters, or by means of recording galvanometers. In the latter case the various frequency components may be identified by Fourier analysis. A weighting factor to be specified may be used in the evaluation of the data obtained.

5.8.8 This measurement can be made with or without time base correction. The results should specify whether the time base correction had been used or not.

5.9 Velocity Errors — It is possible to evaluate the errors approximately by reproducing a colour bar test signal and observing it on a vectorscope. Velocity errors will cause angular spread of the dots representing colours of the bar pattern. This method is severaly restricted by noise.

5.10 Video Signal-to-Noise Ratio — The technique consists of recording and reproducing a 30 percent grey level and 75 percent white level video signal and subsequently removing in the measuring apparatus the H and V pulses and leaving these periods at black level. The loss of noise energy during blanking is taken into consideration when calibrating the measuring instrument. The evaluation may be made on a linear or weighted scale.

The S/N ratio in dB (unweighted) is:

$$\mathrm{S/N} = 20 \log \frac{V_{\mathrm{sig}}\ \mathrm{PP}}{V\ \mathrm{noise\ rms}}$$

V_{sig} is the voltage corresponding to 100 percent amplitude of the noncomposite video.

5.11 Differential Gain

5.11.1 *Method A* — Evaluation of the errorson a vectorscope is possible when viewing a reproduced signal such as colour bars or staircase with superimposed subcarrier.

5.11.2 *Method B* — A subcarrier is extracted from a reproduced test signal by means of a band pass filter, optionally rectified and displayed on an oscilloscope. The measurement accuracy is impaired by noise.

NOTE — Suitable direct reading instruments may also be used.

5.12 Differential Phase

5.12.1 *Method A* — The equipment used in **5.11.1** is also suitable for measuring differential phase. Noise and velocity errors seriously impair the accuracy of the results obtained.

5.12.2 *Method B* — The evaluation of differential phase in magnetic video recording is limited by two reasons:

a) Influence of velocity-errors, and

b) Poor S/N ratio.

5.12.2.1 The test signals for differential phase errors are usually sawtooth or grey-scale-signals at line rate, superimposed with a subcarrier with a suitable amplitude. In case of velocity errors the subcarrier phase is shifted from zero at the beginning to a maximum towards the end of the line. This phase is added to the differential phase error in question and cannot be separated during evaluation.

To overcome this difficulty, a grey-scale signal is proposed, the level of which is changed from line to line. The differential phase error is sampled and measured only at the beginning of the line, where the velocity error is small enough not to influence the result.

The period of the grey scale may be choosen so as to meet the scanning rate of the video heads . In this way in case of quadruplex machines the 4 video channels can be measured separately.

5.12.2.2 Noise reduction by means of integration is an usual technique. Combining the test signal according to **5.12.2.1** which a sample-and-hole device (the integrating time constant of which should be choosen to some tenths of a second) vary accurate figures of differential phase errors may be reached.

NOTE — Suitable direct reading instruments may also be used.

5.13 Moire — The method is suitable for helical scan recorders utilizing direct colour recovering technique.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	Unit	Symbol	Definition
orce	newton	N	1 N = 1 kg.m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2